SECTION 32 17 26

TACTILE SURFACING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Tile Materials

B. Tile Models

C. Fasteners and Accessories

D. Decals

1.02 RELATED SECTIONS

A. Requirements for dielectric insulation at platform edge are specified in Section 03 40 00, Precast Concrete and Section 07 13 19, Modified Bituminous Sheet Waterproofing.

1.03 MEASUREMENT AND PAYMENT

A. Separate measurement and payment will not be made for work required under this Section. All costs in connection with the work specified herein will be considered to be included with the related item of work in the Bid Schedule of the Bid Form or incidental to the Work.

1.04 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO):

1. H20 Load Bearing Specifications

B. ASTM International (ASTM):

1. ASTM B117 Standard Practice for Operating Salt Spray (Fog) Apparatus
2. ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
3. ASTM C97 Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone
4. ASTM C418 Standard Test Method for Abrasion Resistance of Concrete by Sandblasting
5. ASTM C496 Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens

6.	ASTM C501	Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by Tabor Abraser
7.	ASTM C936	Standard Specification for Solid Concrete Interlocking Paving Units
8.	ASTM C947	Standard Test Method for Flexural Properties of Thin-Section Glass-Fiber-Reinforced Concrete (Using Simple Beam with Third-Point Loading)
9.	ASTM C1026	Standard Test Method for Measuring the Resistance of Ceramic and Glass to Tile Freeze-Thaw Cycling
10.	ASTM C1262	Standard Test Method for Evaluating the Freeze-Thaw Durability of Dry-Cast Segmental Retaining Wall Units and Related Concrete Units
11.	ASTM D543	Standard Practice for Evaluating the Resistance of Plastics to Chemical Reagents
12.	ASTM D570	Standard Test Method for Water Absorption of Plastics
13.	ASTM D638	Standard Test Method for Tensile Properties of Plastics
14.	ASTM D695	Standard Test Method for Compressive Properties of Rigid Plastic
15.	ASTM D696	Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C with a Vitreous Silica Dilatometer
16.	ASTM D790	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
17.	ASTM D1037	Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Board Materials
18.	ASTM D2486	Standard Test Methods for Scrub Resistance of Wall Paints
19.	ASTM D5420	Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)
20.	ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
21.	ASTM G151	Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that use Laboratory Light Sources
22.	ASTM G155	Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

C. Federal Standards (FED-STD):

1. FED-STD-595C Colors Used in Government Procurement

1.05 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures, and Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Product Data: Submit manufacturer's product data and installation instructions for the specified tactile warning and directional tiles including adhesives, sealants, and fasteners.

1. Include type and models of tiles to be installed and method of installation for each model.

2. Include dimensioned drawings of tile surface profiles.

3. Include maintenance and cleaning instructions for the tiles.

C. Shop Drawings: Submit the following:

1. Complete installation layout and details including:

a. Scaled and dimensioned plans of tile placement including tile sizes and joint locations.

b. Joint abutment and transition details that provide a smooth, continuous, and flush surface between all tiles including joint abutment between tiles and adjacent flooring, platform edge conditions, sidewalks, and other site conditions where tactile warning surfaces are to be installed.

2. Fabrication details.

3. Fastener types and locations.

4. Internal flange and grouting details, where applicable.

D. Samples: Submit full-size samples of the types of tactile warning and directional tiles to be installed in each color specified for the Engineer’s approval. Samples shall match the Engineer’s control samples.

E. Material Test Reports: Submit test reports from a qualified independent testing laboratory indicating that materials proposed for use are in compliance with requirements and meet the properties specified. Include test report of field testing.

F. Installer's Qualifications: Submit evidence of the tile manufacturer's approval of the qualifications and experience of the proposed installer.

1.06 EXTRA STOCK

A. Furnish new materials from same manufactured lot as materials installed and enclosed in protective packaging with appropriate identification. Furnish not less than two percent of the supplied materials for each type, color and pattern installed.

1.07 QUALITY ASSURANCE

A. Single Source Responsibility: Provide tiles and fasteners as supplied by a single manufacturer.

B. Installer's Qualifications: Engage an experienced installer certified in writing by tile manufacturer as qualified for installation and who has successfully completed tile installations similar in material, design, and scope to that indicated for the Contract.

C. Regulations: Provide tactile warning surfaces that comply with the detectable warnings on walking surfaces as follows:

1. Americans with Disabilities Act (ADA): Title 49 CFR Transportation, Part 37, Appendix A, ADA Accessibility Guidelines for Buildings and Facilities, Section 4.29.

2. California Code of Regulations Title 24, Part 2, California Building Code (CBC), Chapter 11B, Accessibility to Public Buildings, Public Accommodations, Commercial Buildings, and Public Housing.

D. Mock-ups: Provide mock-ups as described and as specified when required by the Contract Specifications Section 32 17 26, Tactile Surfacing.

1.08 DELIVERY, STORAGE AND HANDLING

A. Storage:

1. Store tiles and other materials in an area that is within 40-90 degrees Fahrenheit. Protect other materials from freezing. If manufacturer's storage requirements are more restrictive, comply with manufacturer's requirements.

2. Maintain storage facilities in a clean dry condition.

1.09 SITE CONDITIONS

A. Environmental Conditions and Protection: Maintain minimum temperature of 40 degrees Fahrenheit in spaces to receive tiles for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. Store tiles in spaces where they will be installed for at least 48 hours before beginning installation. Subsequently, maintain minimum temperature of 40 degrees Fahrenheit in areas where work is completed. If manufacturer's requirements are more restrictive, comply with manufacturer's requirements. Comply with manufacturers' requirements for substrate temperatures.

1.10 GUARANTEE

A. In addition to the Guaranty of Work requirements in General Conditions Article GC4.9, tiles shall be guaranteed in writing for a period of five years from date of Acceptance. The guarantee shall include defective work, breakage, deformation, fading and chalking of finishes, and loosening of tiles, and shall cover the cost of labor and materials for repair or replacement.

PART 2 – PRODUCTS

2.01 TILE MATERIALS – PERFORMANCE CRITERIA

A. Sheet Molding Compound (SMC) Tile Material: Matte finish exterior grade glass and carbon reinforced polyester based SMC composite material with uniform color throughout thickness that meets or exceeds the following requirements:

1. Salt and Spray Performance (ASTM B117): No deterioration or other defects after 200 hours of exposure.

2. Abrasion Resistance (ASTM C501): 500 minimum.

3. Freeze/Thaw/Heat (ASTM C1026): No deterioration.

4. Chemical Stain Resistance (ASTM D543): No reaction to 1% hydrochloric acid, motor oil, calcium chloride, gum, soap solution, bleach, and antifreeze.

5. Water Absorption (ASTM D570): Not to exceed 0.10%.

6. Tensile Strength (ASTM D638): 11,600 psi minimum.

7. Compressive Strength (ASTM D695): 28,900 psi minimum.

8. Flexural Strength (ASTM D790): 29,300 psi minimum.

9. Flame Spread (ASTM E84): 25 maximum.

10. Accelerated Weathering (ASTM G151 or G155): $\Delta E<5.0$ at 2,000 hours minimum exposure.

11. Load Bearing (AASHTO H20): No damage at 16,000 pounds loading.

B. Vitrified Polymer Composite (VPC) Tile Material: Epoxy polymer composition that provides aluminum oxide particles in the truncated domes with an ultra-violet resistance matte finish coating that meets or exceeds the following requirements:

1. Salt and Spray Performance (ASTM B117): No deterioration or other defects after 300 hours of exposure.

2. Abrasion Resistance (ASTM C501): 500 minimum.

3. Freeze/Thaw/Heat (ASTM C1026): No deterioration.

4. Chemical Stain Resistance (ASTM D543): No reaction to 1% hydrochloric acid, motor oil, calcium chloride, gum, soap solution, bleach, and antifreeze.

5. Water Absorption (ASTM D570): Not to exceed 0.05%.

6. Tensile Strength (ASTM D638): 11,600 psi minimum.

7. Compressive Strength (ASTM D695): 19,000 psi minimum.

8. Coefficient of Thermal Expansion (ASTM D696): 2.78 x 10^{-6}/°F.

9. Flexural Strength (ASTM D790): 29,300 psi minimum.

10. Accelerated Aging Cycle Testing (ASTM D1037): No failure.

11. Abrasive Scrub Test (ASTM D2486): 0.06 minimum.

12. Impact Resistance (ASTM D5420): 550 in-lbf/in minimum.

13. Flame Spread (ASTM E84): 25 maximum.

14. Accelerated Weathering (G155): $\Delta E<3.0$ at 2,000 hours minimum exposure.

15. Load Bearing (AASHTO H20): No damage at 16,000 pounds loading.

C. High-Tech Concrete (HTC) Tile Material: Polymer mix concrete with blended aggregates formed with integrated domes using inorganic metal oxide pigments that meet or exceed the following requirements:

1. Compressive Strength (ASTM C39): 16,800 psi minimum.

2. Water Absorption (ASTM C97): No to exceed 0.25%.

3. Abrasion Resistance (ASTM C418): Not to exceed 0.008 cm^3/cm^2.

4. Tensile Strength (ASTM C496): 3,000 psi minimum.

5. Flexural Strength (ASTM C947): 3,000 psi minimum.

6. Freeze-Thaw Durability (ASTM C1262): 0.00%.

D. In addition to compliance with the specified test criteria and characteristics, detectable tactile warning surfacing products shall have been successfully field tested in service for a minimum of two years.

E. Detectable Warning Surfaces shall be in compliance with the requirements of CBC Article 11B-705. Requirements include truncated dome size and spacing, color and contrast, resiliency and sound-on-cane contact, requirements for specific locations, and detectable directional texture. Use in-line pattern truncated domes. Staggered pattern domes are not acceptable.

2.02 TILE MODELS

A. The following tile models are applicable to various conditions and locations as indicated in the Drawings or as described elsewhere in the Contract Documents:

1. Model 1: Cast-in-Place Tactile Detectable Warning Surface Tile

2. Model 2: Cast-in-Place Replaceable Tactile Detectable Warning Surface Tile

3. Model 3: Surface Applied Tactile Detectable Warning Surface Tile

4. Model 4: Directional Way-Finding Bar Tile

5. Model 5: Cast-in Place Radius Tactile Surface

6. Model 6: Surface Applied Radius Tactile Surface

7. Model 7: Modular Paver

B. Thickness and Lateral Dimensions: As indicated in the approved Shop Drawings.

1. Exception:

a. Thickness of HTC tile material: 11/16 inch, with a dimensional tolerance of plus or minus 0.0625 inches in accordance with ASTM C936.

C. Flange equipped models: Internal embedment flange of length and spacing as designated in the approved Shop Drawings. Provide 0.625 inch holes in flanges for grout distribution.

D. Color: Color shall be uniform and homogeneous throughout the tile and in conformance with FED-STD-595C as follows:

1. Yellow: Federal Color No. 33538.

2.03 FASTENERS AND GROUTING

A. Where applicable to type of tile material and installation described in the Contract Documents and the approved Shop Drawings, use 304 stainless steel fasteners in a fastening pattern as recommended by the tile manufacturer concealed with color-matched polyvinyl chloride plastic (VPC) caps. Locate fasteners as shown in the approved Shop Drawings.

B. For grout embedment installations:

1. Provide 304 stainless steel leveling bolts as recommended by the tile manufacturer.

2. Provide non-shrink grout over self-leveling mortar bed under tile to thickness as recommended by the tile manufacturer.

2.04 ACCESSORIES

A. Adhesives: As recommended by the tile manufacturer.

B. Perimeter sealant: As recommended by the tile manufacturer. Color: As specified by the Engineer.

2.05 DECALS

A. Printable media for wide format digital printers that applies directly to sealed and unsealed concrete, asphalt, brick tile, terrazzo, marble, vinyl flooring, brick, stucco, and unit masonry wall surfaces:

1. Aluminum foil material that naturally conforms to texture of surface and appears as a printed graphic.

2. Print directly to textured surface with no requirement for over lamination.

3. High friction surface that provides slip resistance and reflectivity.

4. Withstands heavy pedestrian traffic in hot, cold, and wet environments for not less than one year.

5. Installed with high performance pressure sensitive acrylic adhesive backing.

B. Physical Properties:

1. UV curing.

2. Contains no PVC or hazardous chemicals and can be aluminum recycled.

3. Thicknesses:

   a. Film: 16 mil.

   b. Adhesive: 2 mil.

   c. Liner: 5 mil.

4. Service Temperature Range: -40 degrees Fahrenheit to 176 degrees Fahrenheit.

5. Minimum Application Temperature: 32 degrees Fahrenheit minimum.

C. Design and location: As indicated in the Contract Drawings.

PART 3 – EXECUTION

3.01 PREPARATION

A. Substrate Condition: Ensure substrate is in suitable condition and in compliance with the tile manufacturer's recommendations.

B. Verify that concrete substrate has cured a minimum of 30 Days.

3.02 INSTALLATION

A. The application of adhesives, sealants, and mechanical fasteners and the installation of tiles shall be in accordance with the guidelines required by the respective tile manufacturers, the approved material submittals, and the approved Shop Drawings. In general, the following installation guidelines apply, unless specified otherwise by the tile manufacturer:

1. For Cast-in-Place: Pour and float concrete, set tile by tamping down into concrete until all air voids are removed, edge cut around the perimeter, and remove any protective material covering the tile.

2. For Surface Applied: Grind substrate, remove dust on tile and substrate, apply adhesive to back of tile, drill into concrete, install fasteners, clean tile surface, and apply perimeter sealant.

3. For Directional Tile: Grind substrate 3/16 inch deep, six inches wide, saw cut 3/4 inch deep grooves, remove dust on tile and substrate, apply adhesive to back of tile, drill into concrete, install fasteners, clean tile surface, and apply perimeter sealant.

4. For Modular Paver: Box out or saw cut concrete, lay a gravel or mortar bed, tamp paver onto substrate, place a 3/8 inch diameter rope at bottom of all joints, and apply joint sealant.

B. During preparation and installation, protect adjacent surfaces not designated to receive tiles.

C. Do not cut or otherwise alter domes at joints.

D. Mechanically clean surface to receive tile to remove dirt and other foreign material and roughen concrete surface in accordance with tile manufacturer's instructions. After mechanical cleaning has been completed, vacuum and power wash with clean water to remove all dirt and debris. Visually inspect surfaces for obtrusions or foreign matter. If obtrusions are present, grind away before proceeding.

E. Immediately prior to installing setting adhesive and tactile warning surfacing materials, inspect surfaces to ensure that they are structurally sound, clean, and dry, and free of voids, curing compounds, obtrusions, projections, loose material, dust, oil, grease, sealers, and other foreign materials that might prohibit the proper installation of setting adhesive and surfacing material.

F. Set tiles as detailed in the approved Shop Drawings.

G. Following the installation of tiles, apply perimeter sealant system to the joints between abutting tile and between tiles and other adjacent surfaces. Follow sealant manufacturer's recommendation for application and ensure that the joint is clean and free of debris. Cut away any excess adhesive to provide sufficient depth for sealant as required by the sealant manufacturer for the tile installation conditions.

3.03 PROTECTION AND CLEANING

A. Protect adjacent surfaces from damage from adhesives and sealants.

B. Protect tiles, sealant, and cement strip against damage during construction period to comply with manufacturers' specifications.

C. Protect against damage for rolling loads following installation by covering with plywood or hardwood sheets.

D. After areas have been fully tiled and sealant system applied, clean tile surfaces in accordance with the tile manufacturer's recommendations.

E. Clean tiles, using methods recommended by the tile manufacturer, not more than four days prior to date for Final Inspection.

F. Do not allow foot traffic on installed tiles until the perimeter sealant has cured sufficiently to avoid tracking.

3.04 PRINTING AND INSTALLATION OF DECALS

A. Print and install decals as recommended by the decal material manufacturer.

END OF SECTION 32 17 26